PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-066372

(43)Date of publication of application : 06.03.1998

(51)Int.Cl. H02P 3/18
H02M 7/48
H02P 1/30
H02P 7/63

(21)Application number : 08-222415

(22)Date of filing : 23.08.1996

(71)Applicant : MITSUBISHI HEAVY IND LTD

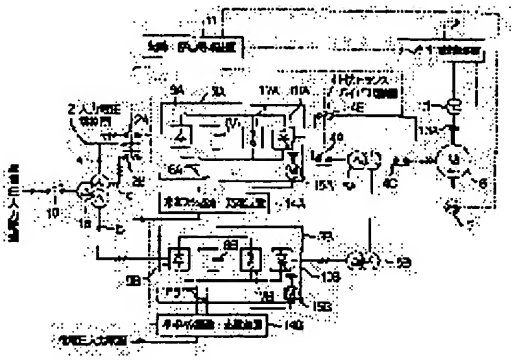
(72)Inventor : KAWASHIMA YUTAKA

(54) INVERTER DEVICE AND CONTROLLER FOR DRIVING MOTOR AND THEIR OPERATING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To quickly and smoothly start and stop a motor by controlling the switching of on/off of a high-voltage tap, a low-voltage tap, an output-input switch, and a by-pass switch at the time of starting and stopping the motor.

SOLUTION: When a motor 6 is started, an input voltage switch 2 turns on a low-voltage tape (c) and a by-pass switch 4B and inverter devices 3A and 3B input low voltages and start a motor 6 by outputting constant alternating currents when a prescribed frequency increases. Then the switch 2 turns on high-voltage taps (a) and (b). In addition, a bypass switch 4B is turned off and output switches 4A and 4C are turned on. The inverter devices 3A and 3B output high voltages and drive the motor 6 after the voltages are boosted by means of an output transformer by outputting constant currents when a prescribed frequency increases. When the motor 6 is stopped, the switch 2, high-voltage taps (a) and (b), low-voltage taps (c), by-pass switch 4B, etc., are actuated in the reverse order of the above-mentioned order.



LEGAL STATUS

[Date of request for examination] 24.03.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the

examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3402949

[Date of registration] 28.02.2003

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The inverter equipment for a motor drive characterized by to have the input transformer which has a high-pressure tap and a low-voltage tap, the inverter equipment which were connected to a high-pressure tap and the low-voltage tap through the input-voltage means for switching, the switch for an output which were connected to inverter equipment, the output transformer which were connected to the switch for an output, and the switch for a bypass which were connected to inverter equipment that an output transformer should bypass in the inverter equipment of a motor for a drive.
[Claim 2] Inverter equipment is a control unit of the inverter equipment for a motor drive according to claim 1 characterized by having starting and stop control which has a rectifier, a smoothing capacitor, an inverter, and a motor for cooling fans, and carries out frequency control of the inverter equipment, and the cooling-fan drive and charging equipment which carry out frequency control of the motor for cooling fans while charging with a fixed current at a smoothing capacitor.
[Claim 3] The operating method which starts the motor by the inverter equipment for a motor drive according to claim 1 characterized by turning ON the switch for a bypass, making the output frequency of inverter equipment increase while switching an input voltage means for switching to a low voltage tap side, turning ON the switch for OFF and an output for the switch for a bypass, and making the output frequency of inverter equipment increase while switching an input voltage means for switching to a high-pressure tap side after that.
[Claim 4] While connecting an input voltage means for switching to a high-pressure tap side, turn ON the switch for an output, decrease the output frequency of inverter equipment, and regenerative braking performs high-voltage moderation operation. While connecting an input voltage means for switching to a low voltage tap side next, turn ON a bypass switch, decrease the output frequency of inverter equipment, and regenerative braking performs low-battery moderation operation. The operating method which suspends the motor by the inverter equipment for a motor drive according to claim 1 characterized by carrying out the output of inverter equipment to a direct current after that, and performing direct-current braking halt operation.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the inverter equipment and the control unit for a motor drive, and operating method which start and suspend a motor smoothly with the inverter of a polyphase form.
[0002]
[Description of the Prior Art] The inverter equipment main circuit schematics of the polyphase form for the conventional motor drive are shown in drawing 7 , and the operation is shown in drawing 8 .
[0003] As shown in drawing 7 , when receiving high-voltage input power, controlling a frequency by inverter equipment and driving the mass motor 6 of the high voltage, since inverter equipment has low rated voltage, the input transformer 01 for voltage drops is arranged.
[0004] Furthermore, since the rated capacity of inverter equipment 3A also has a limit, two or more inverter equipments 3A and 3B are required, and the output composition transformers 5A and 5B which served also as ****** are arranged.
[0005] The input transformer 01 is constituted by the delta coil for an input, the star coil for an output, and the delta coil for an output.
[0006] The high-pressure tap a of the star coil for the output of an input transformer 01 is connected to inverter equipment 3A, and the high-pressure tap b of the delta coil for an output is connected to inverter equipment 3B.
[0007] In addition, the inverter equipments 3A and 3B are constituted by Rectifiers 9A and 9B, smoothing capacitors 8A and 8B, and the GTO (gate turnoff) inverters 10A and 10B for an output. Moreover, PWM (Pulse Density Modulation) control of these inverters 10A and 10B is carried out, and the frequency of an output, the electrical potential difference, etc. are controlled.
[0008] As the output of inverter equipment 3A is shown in drawing 3 , it connects with the delta coil for the input of output composition transformer 5A, and the output of inverter equipment 3B is connected to the delta coil for the input of output composition transformer 5B.
[0009] And the output voltage which the electrical potential difference 30 degrees of phases shifted [electrical potential difference] from the inverter equipments 3A and 3B mutually is inputted, and was compounded by the star coil of output composition transformer 5A and the double star coil of output composition transformer 5B becomes a thing adding the output voltage of the inverter equipments 3A and 3B at the output composition transformers 5A and 5B, respectively. And this compounded output voltage is outputted to the mass motor 6.
[0010] In addition, the cooling fan and motor which are not illustrated to the inverter equipments 3A and 3B in order to cool Rectifiers 9A and 9B, Inverters 10A and 10B, etc. are arranged, and in order to start a motor 6, turning gear and a motor are connected with the motor 6 through the clutch which is not illustrated.
[0011] In an above-mentioned configuration, in starting a motor 6, first, it starts by turning gear and raises a rotational frequency to 1% (it is 0.6Hz when commercial frequency is 60Hz) extent of rated frequency.
[0012] Then, a clutch is de**(ed) and it is made to speed oneself up to rated frequency with the inverter equipments 3A and 3B.
[0013] At this time, as shown in drawing 8 , as for the lowest frequency by the inverter equipments 3A and 3B which can be operated, it is desirable to carry out to 5% or more of rated frequency. And although a modulation factor rises in proportion to a frequency, the direct-current intermediate voltage ratio and the rate of the maximum current ratio (torque) are 100%.
[0014]
[Problem(s) to be Solved by the Invention] The above-mentioned conventional equipment had the following troubles.

(a) High-pressure direct-current intermediate voltage is fixed, and the minimum modulation factor is decided from the constraint based on formation of the electrical-potential-difference vector of the armature-voltage control by PWM (pulse width modulation) control of an inverter. that is, when lowest frequency was comparatively alike in the GTO inverter by PWM control and turned into a high frequency, in the big system of a starting torque, it might become the cause of starting failure according to the torque fall and overcurrent generating at the time of (i) starting (ii) Since a rotational frequency with effective regenerative braking was completed on comparatively high frequency and electrical potential difference when carrying out regenerative braking and carrying out a rotational fall rate early at the time of a halt, it had become the cause of stop-time extension.
(b) In a low frequency region, output voltage also declines in proportion to a frequency, and the reactance (it contributes to a starting torque) of a motor 6 also falls. However, since the output current was fixed, the voltage drop by the wirewound resistor of the output composition transformers 5A and 5B and a motor 6 became large relatively, as a result, since the power for starting to a load side declined, the fall of a starting torque arose and the motor etc. had become failure in starting, and the extended cause of warm-up time.
(c) Since direct-current braking is not hung, time amount great by the drop dead halt is required by becoming the halt actuation which carries out SHA ** of the output of the inverter equipments 3A and 3B.
(d) Moreover, for a short-time drop dead halt, a mechanical brake etc. needs to be used together.
[0015]
[Means for Solving the Problem] This invention adopts the following means in order to solve the above-mentioned technical problem.
(1) The inverter equipment for a motor drive characterized by to have the input transformer which has a high-pressure tap and a low-voltage tap, the inverter equipment which were connected to a high-pressure tap and a low-voltage tap through an input-voltage means for switching, the switch for an output which were connected to inverter equipment, the output transformer which were connected to the switch for an output, and the switch for a bypass which were connected to inverter equipment that an output transformer should bypass in the inverter equipment of a motor for a drive.
[0016] A low voltage tap turns on by the input voltage means for switching above at the time of motor starting. Moreover, the switch for a bypass turns on. And low voltage is inputted, and inverter equipment is the increment in a frequency defined beforehand, and it outputs the alternating current of a fixed current and drives a motor. A high-pressure tap turns on by the input voltage means for switching after that. Moreover, the switch for a bypass turns off and the switch for an output turns on. And inverter equipment inputs high pressure, is the increment in a frequency defined beforehand, and outputs the alternating current of a fixed current, and drives a motor after a pressure up with an output transformer.
[0017] Quick and smooth starting of a reliable motor is attained as mentioned above.
[0018] At the time of a motor halt, an input voltage means for switching, a high-pressure tap, a low voltage tap, the switch for an output, the switch for a bypass, etc. operate by the above and the reverse order, and slow down a motor. And direct-current braking is applied by inverter equipment, and it stops just before a halt.
[0019] A quick and smooth halt is attained by the reliable low loss of a motor as mentioned above.
(2) Inverter equipment is a control unit of the inverter equipment for a motor drive given in the above (1) characterized by having starting and stop control which has a rectifier, a smoothing capacitor, an inverter, and a motor for cooling fans, and carries out frequency control of the inverter equipment, and the cooling-fan drive and charging equipment which carry out frequency control of the motor for cooling fans while charging with a fixed current at a smoothing capacitor.
[0020] While a cooling-fan drive and charging equipment charge a smoothing capacitor with a fixed current with the control signal from starting and stop control above, the control drive of the motor for cooling fans is carried out, and an inverter is cooled.
(3) The operating method which starts in the motor by the inverter equipment for a motor drive given in the above (1) characterized by to turn ON the switch for a bypass, to make the output frequency of inverter equipment increase while switching an input-voltage means for switching to a low-voltage tap side, to turn ON the switch for OFF and an output for the switch for a bypass, and to make the output frequency of inverter equipment increase while switching an input-voltage means for switching to a high-pressure tap side after that.
[0021] A low voltage tap side turns on by the input voltage means for switching above at the time of starting, and the switch for a bypass turns on, and the output frequency of inverter equipment carries out a sequential increment, and puts a motor into operation. When it becomes a predetermined frequency, similarly, it switches to the high-pressure tap

side ON, and the switch for OFF and an output turns [the switch for a bypass] on, and the output frequency of inverter equipment carries out a sequential increment, and carries out the accelerating drive of the motor.
(4) While connecting an input voltage means for switching to a high-pressure tap side, turn ON the switch for an output, decrease the output frequency of inverter equipment, and regenerative braking performs high-voltage moderation operation. While connecting an input voltage means for switching to a low voltage tap side next, turn ON a bypass switch, decrease the output frequency of inverter equipment, and regenerative braking performs low-battery moderation operation. The operating method which suspends the motor by the inverter equipment for a motor drive given in the above (1) characterized by carrying out the output of inverter equipment to a direct current after that, and performing direct-current braking halt operation.
[0022] A high-pressure tap side turns on by the input voltage means for switching above at the time of a halt, and the switch for an output turns on, the output frequency of inverter equipment carries out sequential reduction, and a motor is slowed down. When it becomes a predetermined frequency, similarly, it switches to the low voltage tap side ON, and the switch for ON and an output turns [the switch for a bypass] off, the output frequency of inverter equipment carries out sequential reduction, and a motor is slowed down. Being flowing in one direction after that, a motor carries out direct-current braking.
[0023]
[Embodiment of the Invention] When drawing 1 - drawing 6 explain the gestalt of operation of this invention, drawing 1 is the circuit diagram of the 1st gestalt of operation of this invention, and drawing 2 is the circuit diagram of the output composition transformer of the 1st gestalt.
[0024] Drawing 3 is [the operation explanatory view of the 1st gestalt and drawing 5 of the flows-of-control Fig. at the time of starting of the 1st gestalt and drawing 4] the flows-of-control Figs. at the time of a halt of the 1st gestalt.
[0025] Drawing 6 is the circuit diagram of the 2nd gestalt of operation of this invention.
[0026] In addition, in drawing 1 and drawing 6 , the thing of the same sign as drawing 7 is a conventional thing and a conventional equal configuration member.
(Configuration of the 1st gestalt of operation of this invention) Drawing 1 - drawing 5 explain the gestalt of operation of this invention.
[0027] As shown in drawing 1 , when receiving high-voltage input power through an electric power switch 18, controlling a frequency by the inverter equipments 3A and 3B and driving the mass motor 6 of the high voltage, since rated voltage is low, as for the inverter equipments 3A and 3B, input transformer 1a for ****** is arranged.
[0028] Furthermore, while compounding the output of the inverter equipments 3A and 3B, in order to ****** output voltage to the rated voltage of a motor 6, the output composition transformers 5A and 5B are arranged.
[0029] In addition, although the inverter equipments 3A and 3B are made into 2 sets, this number of groups may be determined according to the capacity of a motor 6, as long as the capacity of a motor 6 is small, the number of inverter equipments one, and if it is large capacity more, according to the capacity of a motor 6, inverter equipment can be conversely made into 3 or more sets.
[0030] Input transformer 1a is constituted by the delta coil for an input, the star coil for an output, and the delta coil for an output.
[0031] And high-pressure input power is connected to the delta coil for an input through the electric power switch 18. The high-pressure tap a (electrical potential difference = HV) and the low voltage tap c (electrical potential difference = LV) are formed in the star coil for an output. Moreover, the high-pressure tap b (electrical potential difference = HV) is formed in the delta coil for an output.
[0032] In addition, although voltage ratio HV/LV is set to one third with the 1st gestalt of this operation, it is not limited to this.
[0033] The high-pressure tap a of input transformer 1a and the low voltage tap c are connected to inverter equipment 3A through switch 2A for a high-voltage input of the input voltage change-over machine 2, and switch 2B for a low-battery input, respectively.
[0034] Moreover, the high-pressure tap b of input transformer 1a is connected to inverter equipment 3B.
[0035] In addition, switch 2A for a high-voltage input and switch 2B for a low-battery input are interlocked, and are turned on in coincidence.
[0036] The inverter equipments 3A and 3B are constituted by the GTO inverters 10A and 10B for an output which change into a three-phase-circuit alternating current the smoothing capacitors 8A and 8B and direct current which carry out smooth [of the pulsating flow from the rectifiers 9A and 9B for 3 set full wave rectification, and Rectifiers 9A and 9B] respectively.

[0037] Furthermore, in order to emit the back flow power from a motor 6 at the time of a halt of a motor 6, the dampers 17A and 17B which consist of a resistor and a rectifier are formed in the inverter equipments 3A and 3B.
[0038] In addition, as for the GTO inverters 10A and 10B, the frequency of an output, the electrical potential difference, etc. are controlled by PWM (Pulse Density Modulation) control. In this PWM control, based on the modulated wave of the same frequency as a target frequency, and the subcarrier of 3 corniform of the frequency more than a modulated wave, switching of each inverters 10A and 10B is controlled, and a modulation factor, a pulse number, pulse width, and the output voltage of an inverter change in proportion to a target frequency.
[0039] Moreover, a cooling fan and the cooling-fan motors 15A and 15B are respectively arranged by the inverter equipments 3A and 3B. Furthermore, charge Rhine 16 is connected to smoothing capacitors 8A and 8B. In addition, electric power is supplied to the power for the charge to the cooling-fan motors 15A and 15B and smoothing capacitors 8A and 8B from a cooling-fan drive and charging equipment 14A and 14B.
[0040] Electric power is supplied to the output of inverter equipment 3A by the mass motor 6 via switch 4B for a bypass of the output transformer bypass change-over machine 4.
[0041] Furthermore, the output of inverter equipment 3A is connected to the delta coil for an input of output composition transformer 5A as shown in switch 4for high-voltage output A of the output transformer bypass change-over machine 4, and drawing 2 .
[0042] On the other hand, the output of inverter equipment 3B is connected to the delta coil for an input of output composition transformer 5B as shown in drawing 2 .
[0043] And the double star coil for an output of output composition transformer 5B is connected to the end of the star coil for an output of output composition transformer 5A, thereby, the output of 2 sets of inverter equipments 3A and 3B is compounded, and the other end of the star coil for an output of output composition transformer 5A is connected to the mass motor 6 via contact 4C for a bypass of the output transformer bypass change-over machine 4.
[0044] In addition, the switches 4A and 4C for a high-voltage output of the output transformer bypass change-over machine 4 and switch 4B for a bypass are interlocked, and are turned on in coincidence.
[0045] Moreover, the motor 6 is connected with the turning-gear motor 13 through clutch 13A. Moreover, the rotation detector 7 is attached in the motor 6.
[0046] And in order to control each above-mentioned equipment, starting and stop control 11, a cooling-fan drive and charging equipment 14A and 14B, and the turning-gear control unit 12 are arranged.
[0047] Starting and stop control 11 control turning on and off of the input voltage change-over machine 2 and the output transformer bypass change-over machine 4.
[0048] Moreover, starting and stop control 11 perform generalization control of the turning-gear control unit 12, and a cooling fan and charge control units 14A and 14B.
[0049] Furthermore, starting and stop control 11 send the switching signal of the inverter of the inverter equipments 3A and 3B for carrying out PWM (pulse width modulation) control according to a target frequency.
[0050] The turning-gear control device 12 controls attachment and detachment of the drive of the turning-gear motor 13, and clutch 13A.
[0051] A cooling-fan drive and charging equipment 14A and 14B are constituted by the inverter which is not illustrated, the pressure-up transformer, and the rectifier.
[0052] And at the time of operation of the cooling-fan motors 15A and 15B, the above-mentioned inverter performs revolving speed control of the cooling-fan motors 15A and 15B. Moreover, at the time of fixed current charge of smoothing capacitors 8A and 8B, it charges with a fixed current through charge Rhine 16 with the above-mentioned inverter, a pressure-up transformer, and a rectifier.
(Control of starting of the 1st gestalt of operation of this invention) In an above-mentioned configuration, starting of a motor 6 is controlled to be shown in the flows of control of drawing 3 .
[0053] The control at the time of starting is classified into three big steps.
[0054] That is, if mechanical driving gears (turning gear etc.) perform a crawling starting process first (step 2), the decrease electrical-potential-difference inverter starting process by the low battery is performed on the frequency of 0.6Hz (1% of a nominal speed) (step 3) and a frequency finally amounts to 6Hz (10% of a nominal speed), input voltage will be switched to the high voltage (rated voltage), and a rated voltage inverter starting process (step 3) will be performed.
[0055] Below, it explains per detail of each steps 2, 3, and 4.
[0056] First, an electric power switch 18 and all switch 2A, 2B, and 4A, 4B and 4C check that it is off before starting initiation (step S11).

[0057] And a starting start signal is transmitted to the turning-gear control unit 12, and a cooling-fan drive and charging equipment 14A and 14B from starting and stop control 11 (step S12).
[0058] In the crawling starting process of step 2, first, with the turning-gear control device 12, a starting start signal is received and clutch 13A is inserted in (step S21).
[0059] And the turning-gear motor 13 is driven, a motor 6 is started and a predetermined time (T1) speedup is carried out (step S22).
[0060] In addition, this predetermined time (T1) is based on the starting performance of a motor 6, and is calculated and set up beforehand.
[0061] If the engine speed of a motor 6 speeds itself up to lowest frequency f1 =0.6Hz (1% of rated frequency), while de**(ing) clutch 13A, the turning-gear motor 13 is turned OFF and a turning completion signal is sent to starting and stop control 11 (step S23).
[0062] This completes the crawling starting process of step 2.
[0063] On the other hand, in parallel to the crawling starting process of step 2, by a cooling-fan drive and charging equipment 14A, a starting start signal is received and it charges with a fixed current to smoothing capacitor 8A (step S61).
[0064] In addition, inverter equipment 3A ends this charge, when it becomes an electrical potential difference (low battery) in case the electrical potential difference of smoothing capacitor 8A is [switch 2B for a low-battery input] ON.
[0065] Furthermore, in parallel to the crawling starting process of step 2, a cooling-fan drive and charging equipment 14B also receive a starting start signal, and charges with a fixed current to smoothing capacitor 8B (step S62).
[0066] In addition, the electrical potential difference of smoothing capacitor 8B ends this charge, when it becomes rated voltage.
[0067] Next, it sets in the decrease electrical-potential-difference inverter starting process of step 3. In starting and stop control 11 A turning completion signal is received and the completion signal of charge is also received if needed from a cooling fan and the charge control units 14A and 14B (in addition, reception of each completion signal of charge). it may be before ON of an electric power switch 18, in order to connect an input to the low voltage tap c side, after carrying out Switch 2B for a low-battery input of the input voltage change-over machine 2 is turned ON, and further, in order to bypass an output transformer 5, switch 4B for a bypass of the output transformer bypass change-over machine 4 is turned ON (step S31). An electric power switch 18 is turned ON after that (step 32), and electric supply is started.
[0068] And with a low battery (LV), the switching signal which predetermined time (T2) and a frequency **** is transmitted to inverter 10A (step S33), and accelerating operation is performed until it is set to change-over frequency f2 =6Hz (10% of rated frequency) from lowest frequency f1 =1.2Hz if needed [the time schedule or if needed] which was set up beforehand by making the signal of the number of rotations of the motor from the rotation detector 7 into a feedback signal.
[0069] In addition, although an electrical potential difference also rises in proportion to a frequency, since it is considering as the low battery, as shown in drawing 4 , direct-current intermediate voltage is usual 1/3.
[0070] In order to obtain the output voltage ratio usual in this condition, the modulation factor is increased about 3 usual times (=HV/LV). For this reason, the rate of the maximum current ratio to the rated current of a motor 6 is pressed down to 150%.
[0071] Then, after detecting that the rotational frequency was set to change-over frequency f2 =6Hz from the rotation detector 7 and turning OFF (step 34) the period of predetermined time (T3), and an electric power switch 18, while also turning OFF switch 2B for a low-battery input of the input voltage change-over machine 2, switch 4B for a bypass of the output transformer bypass change-over machine 4 is also turned OFF (step S35).
[0072] This completes the decrease electrical-potential-difference inverter starting process of step 3.
[0073] Moreover, with a cooling-fan drive and charging equipment 14A and 14B, it charges with a fixed current to smoothing capacitors 8A and 8B between predetermined time (T3) (in addition, after step 34 is available for initiation of this the charge of each). (step S63, step S64)
[0074] The electrical potential difference of smoothing capacitors 8A and 8B ends this charge, when the inverter equipments 3A and 3B become an electrical potential difference (high voltage/rated voltage) in case switch 2A for a high-voltage input is ON.
[0075] In addition, since it has not carried out movable [of the inverter equipment 3B] at step 3, smoothing capacitor 8B is in a condition [having charged at step 62], and charge of step 64 is ideally unnecessary.
[0076] However, since the charge electrical potential difference is falling by leakage when the period of step 3 is long,

it charges again. Therefore, step 64 is unnecessary what has the short period of step 3.
[0077] Next, it shifts to the rated voltage inverter starting process of step 4.
[0078] In starting and stop control 11, after predetermined time (T3) progress and after also receiving the completion signal of high-voltage charge if needed from a cooling-fan drive and charging equipment 14A and 14B (before ON of an electric power switch 18 is convenient for reception of each completion signal of charge in addition), in order to connect an input to the high-pressure tap a side, switch 2A for a high-voltage input of the input voltage change-over machine 2 is turned ON.
[0079] Furthermore, since output composition transformer 5A is minded, the switches 4A and 4C for a high-pressure output of the output transformer bypass change-over machine 4 are turned ON (step S41).
[0080] Then, it energizes by turning ON an electric power switch 18.
[0081] With the inverter equipments 3A and 3B, the high-pressure middle direct current voltage of smoothing capacitors 8A and 8B is switched by using the number signal of rotations from the rotation detector 7 as the base, the alternating current power which goes up from the change-over frequency f2 to an operation frequency by the predetermined pattern (the minimum modulation factor) is outputted, and accelerating operation is performed (step S43).
[0082] In this case, as shown in drawing 4 , direct-current intermediate voltage and the rate of the maximum current ratio are 100%, and the modulation factor has also become the usual thing.
[0083] A motor 6 will receive this alternating current power through the output composition transformers 5A and 5B, rotation will be raised according to an input, it will be in operational status, starting is completed, and it usually operates (step S5).
[0084] Quick and smooth starting of a motor 6 is attained as mentioned above.
[0085] In addition, in a cooling-fan drive and charging equipment 14A and 14B, the completion signal of a high-pressure switch is received from starting and stop control 11, and operation of the cooling-fan motors 15A and 15B and frequency control are started (in addition (steps S65 and S66), after step 42 is available for initiation of this operation of each).
[0086] This frequency is respectively controlled according to the temperature of the inverters 10A and 10B of the inverter equipments 3A and 3B etc.
[0087] In addition, when the charge to smoothing capacitors 8A and 8B is unnecessary, control of steps S61, S62, S63, S64, and S65 can be omitted.
[0088] Moreover, it is not necessary to double strictly the charge electrical potential difference to smoothing capacitors 8A and 8B with the electrical potential difference at the time of operation of the GTO inverters 10A and 10B. Namely, what is necessary is just about 100% **30 - 40% of an electrical potential difference at the time of operation that what is necessary is just to charge to the electrical potential difference of extent which can prevent an excessive current at the time of the injection when turning on an electric power switch 18.
[0089] Furthermore, in not performing revolving speed control of the cooling-fan motors 15A and 15B (namely, fixed rotation operation), control of steps S64 and S65 is only turning on an electric power switch.
(Control of a halt of the 1st gestalt of operation of this invention) Next, a halt of a motor 6 is performed, as shown in the flows of control of drawing 5 .
[0090] The control at the time of a halt is classified into three big steps.
[0091] Namely, 2 sets of inverter equipments 3A and 3B perform the high-voltage moderation process by regenerative braking by the high voltage first (step 7). If a frequency amounts to 3Hz (5% of a nominal speed), inverter equipment 3A will perform the low-battery moderation process by regenerative braking (step 7). If a frequency finally amounts to 1.2Hz (2% of a nominal speed), the direct-current braking moderation process (step 9) by inverter equipment 3A will be performed, and it is made to stop.
[0092] Below, it explains per detail of each steps 7-9.
[0093] First, a halt start signal is sent by hand control etc. (step 6).
[0094] And in a high-voltage moderation process (step 7), that a frequency and an electrical potential difference should be descended from an operation frequency (60Hz) with time amount to the change-over frequency f3 (3Hz) according to a halt pattern, by making the signal from the revolution-rate-detection machine 7 into a feedback signal, starting and stop control 11 reduce a modulation factor, and goes by the input of the high voltage.
[0095] And according to this modulation factor, the switching signal of the inverters 10A and 10B of the inverter equipments 3A and 3B is sent (step S71).
[0096] That is, the output frequency of the inverter equipments 3A and 3B is reduced so that the skid of an induction

motor 6 may be subtracted.
[0097] Then, a motor 6 generates the power according to the skid. This generated power is returned to the inverter equipments 3A and 3B, and is consumed by the resistor of the dampers 17A and 17B in inverter equipment 3A and 3B.

[0098] Thus, moderation operation of the motor 6 is carried out by regenerative braking by the high voltage.
[0099] And it detects that the signal from the rotational frequency detector 7 was set to 3Hz or less (step 72), and shifts to the following low-battery moderation process (step 8).
[0100] In a low-battery moderation process (step 8), the power-source step 18 is turned OFF first (step 81).
[0101] Then, at a cooling-fan drive and charging equipment 14B, it charges with a fixed current to smoothing capacitor 8B (step S67). This charge is ended when the electrical potential difference of smoothing capacitor 8B becomes the same as the electrical potential difference (high voltage/rated voltage) of inverter equipment 3A in case switch 2A for a high-voltage input is ON. And operation of inverter equipment 3B is ended. Moreover, operation of cooling-fan motor 15B by a cooling-fan drive and charging equipment 14B is also suspended.
[0102] And after turning OFF switch 2for high-voltage input A, and the switches 4A and 4C for a high-voltage output with starting and stop control 11 in order to switch an input to a low voltage tap side, switch 2B for a low-battery input and switch 4B for a bypass are turned ON (step S82).
[0103] Then, after also receiving the completion signal of high-voltage charge from a cooling-fan drive and charging equipment 14B again if needed, an electric power switch 18 is turned OFF (step 83).
[0104] That a frequency and an electrical potential difference should be descended from an operation frequency (3Hz) with time amount to the change-over frequency f4 (1.2Hz) according to a halt pattern, by making the signal from the revolution-rate-detection machine 7 into a feedback signal, starting and stop control 11 reduce a modulation factor, and goes by the input of a low battery.
[0105] And the switching signal of inverter 10A of inverter equipment 3A according to this modulation factor is sent (step S84).
[0106] That is, the output frequency of the inverter equipments 3A and 3B is reduced so that the skid of an induction motor 6 may be subtracted.
[0107] Then, a motor 6 generates the power according to the skid. This generated power is returned to inverter equipment 3A, and is consumed by the resistor of damper 17A in inverter equipment 3A.
[0108] Thus, moderation operation of the motor 6 is carried out by regenerative braking by the low battery.
[0109] And it detects that the signal from the rotational frequency detector 7 was set to 1.2Hz or less (step 85), and shifts to the following direct-current braking process (step 9).
[0110] In a direct-current braking process (step 9), inverter 10of inverter equipment 3A A is controlled by starting and stop control 11, and direct-current braking operation is performed with it.
[0111] namely, the motor 6 -- direct current voltage (or low frequency to reverse) -- in addition, the stator of a motor 6 is made to generate a nonrotation field (or rotating magnetic field of the low frequency to reverse) Then, a short-circuit current flows to the rotator of a motor 6, and a brake force occurs.
[0112] Thus, brakes are applied for a frequency from the change-over frequency f4 (1.2Hz) to 0 (step S92).
[0113] Thereby, a motor 6 completes a halt quickly and smoothly by direct-current braking (step S10).
[0114] Like the above, starting and a halt of the mass motor 6 are performed quickly and smoothly by low loss.
(Configuration of the 2nd gestalt of operation of this invention) Drawing 6 explains the 2nd gestalt of operation of this invention.
[0115] In drawing 6 , the thing of the same sign as drawing 1 is the 1st gestalt and equal configuration member of operation of this invention.
[0116] In the 2nd gestalt of operation of this invention, since a motor 6 is below the rated capacity of inverter equipment 3A, a different point from the 1st gestalt is having made inverter equipment 3A, cooling-fan and motor 15A, and a cooling-fan drive and charging equipment 14A into 1 set.
[0117] Therefore, the coil for an output is made into one piece in input transformer 1b, and an output transformer 5 turns into a mere pressure-up transformer.
(Control of the 2nd gestalt of operation of this invention) The same control as control of starting and a halt of the 1st gestalt of operation of this invention which control of starting and a halt of the 2nd gestalt of operation of this invention shows to drawing 3 and drawing 5 except inverter equipment 3A, cooling-fan and motor 15A, and a cooling-fan drive and charging equipment 14A being 1 set is performed.
[0118] That is, in the control at the time of starting shown in drawing 3 , steps S62, S64, and S66 become unnecessary.

[0119] Moreover, in the control at the time of a halt shown in drawing 5 , steps S67 and S68 become unnecessary.
[0120] As mentioned above, although inverter equipment, a cooling fan and a motor, and a cooling-fan drive and charging equipment explained per 1 set or 2 sets of gestalten, they are not limited to this and can apply similarly [in the case of 3 or more sets].
[0121] Moreover, in each example, since the electric power switch 18 is turned on and off whenever it switches, each switch of the input voltage change-over machine 2 and the output transformer bypass change-over machine 4 can adopt the cheap contactor for a non-energized change-over, a disconnector, a contact, etc.
[0122] As explained above, the following effectiveness is done so in the gestalt of each operation.
** The torque fall and overcurrent generating at the time of starting are lost.
** By tap change-over of high pressure and the low-tension side, the minimum modulation factor constraint of an inverter can be avoided and smooth and quick adjustable cycle starting doubled with the motor property is attained.
** By tap change-over of high pressure and the low-tension side, the minimum modulation factor constraint of an inverter can be avoided, regenerative braking becomes possible to a low frequency and an electrical potential difference, and smooth and quick moderation operation doubled with the motor property is attained.
** A halt of the motor by direct-current braking is further attained by tap change-over of the low-tension side.
** the large capacity which cannot perform halt and starting only with one inverter by using two or more two inverters and output composition transformers -- it also receives electric and the above-mentioned starting, operation, and a halt are attained.
[0123]
[Effect of the Invention] As explained above, this invention does the following effectiveness so.
(a) Regenerative braking of a motor becomes possible and smooth and rapid halt and starting can be performed in low loss.
(b) By tap change-over of high pressure and the low-tension side, the minimum modulation factor constraint of an inverter can be avoided and smooth and quick adjustable cycle halt starting doubled with the motor property is attained.

(c) An inverter is effectively cooled according to actuation (heat release).

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] The inverter equipment main circuit schematics of the polyphase form for the conventional motor drive are shown in drawing 7 , and the operation is shown in drawing 8 .
[0003] As shown in drawing 7 , when receiving high-voltage input power, controlling a frequency by inverter equipment and driving the mass motor 6 of the high voltage, since inverter equipment has low rated voltage, the input transformer 01 for voltage drops is arranged.
[0004] Furthermore, since the rated capacity of inverter equipment 3A also has a limit, two or more inverter equipments 3A and 3B are required, and the output composition transformers 5A and 5B which served also as ****** are arranged.
[0005] The input transformer 01 is constituted by the delta coil for an input, the star coil for an output, and the delta coil for an output.
[0006] The high-pressure tap a of the star coil for the output of an input transformer 01 is connected to inverter equipment 3A, and the high-pressure tap b of the delta coil for an output is connected to inverter equipment 3B.
[0007] In addition, the inverter equipments 3A and 3B are constituted by Rectifiers 9A and 9B, smoothing capacitors 8A and 8B, and the GTO (gate turnoff) inverters 10A and 10B for an output. Moreover, PWM (Pulse Density Modulation) control of these inverters 10A and 10B is carried out, and the frequency of an output, the electrical potential difference, etc. are controlled.
[0008] As the output of inverter equipment 3A is shown in drawing 3 , it connects with the delta coil for the input of output composition transformer 5A, and the output of inverter equipment 3B is connected to the delta coil for the input of output composition transformer 5B.
[0009] And the output voltage which the electrical potential difference 30 degrees of phases shifted [electrical potential difference] from the inverter equipments 3A and 3B mutually is inputted, and was compounded by the star coil of output composition transformer 5A and the double star coil of output composition transformer 5B becomes a thing adding the output voltage of the inverter equipments 3A and 3B at the output composition transformers 5A and 5B, respectively. And this compounded output voltage is outputted to the mass motor 6.
[0010] In addition, the cooling fan and motor which are not illustrated to the inverter equipments 3A and 3B in order to cool Rectifiers 9A and 9B, Inverters 10A and 10B, etc. are arranged, and in order to start a motor 6, turning gear and a motor are connected with the motor 6 through the clutch which is not illustrated.
[0011] In an above-mentioned configuration, in starting a motor 6, first, it starts by turning gear and raises a rotational frequency to 1% (it is 0.6Hz when commercial frequency is 60Hz) extent of rated frequency.
[0012] Then, a clutch is de**(ed) and it is made to speed oneself up to rated frequency with the inverter equipments 3A and 3B.
[0013] At this time, as shown in drawing 8 , as for the lowest frequency by the inverter equipments 3A and 3B which can be operated, it is desirable to carry out to 5% or more of rated frequency. And although a modulation factor rises in proportion to a frequency, the direct-current intermediate voltage ratio and the rate of the maximum current ratio (torque) are 100%.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] The inverter equipment main circuit schematics of the polyphase form for the conventional motor drive are shown in drawing 7 , and the operation is shown in drawing 8 .
[0003] As shown in drawing 7 , when receiving high-voltage input power, controlling a frequency by inverter equipment and driving the mass motor 6 of the high voltage, since inverter equipment has low rated voltage, the input transformer 01 for voltage drops is arranged.
[0004] Furthermore, since the rated capacity of inverter equipment 3A also has a limit, two or more inverter equipments 3A and 3B are required, and the output composition transformers 5A and 5B which served also as ****** are arranged.
[0005] The input transformer 01 is constituted by the delta coil for an input, the star coil for an output, and the delta coil for an output.
[0006] The high-pressure tap a of the star coil for the output of an input transformer 01 is connected to inverter equipment 3A, and the high-pressure tap b of the delta coil for an output is connected to inverter equipment 3B.
[0007] In addition, the inverter equipments 3A and 3B are constituted by Rectifiers 9A and 9B, smoothing capacitors 8A and 8B, and the GTO (gate turnoff) inverters 10A and 10B for an output. Moreover, PWM (Pulse Density Modulation) control of these inverters 10A and 10B is carried out, and the frequency of an output, the electrical potential difference, etc. are controlled.
[0008] As the output of inverter equipment 3A is shown in drawing 3 , it connects with the delta coil for the input of output composition transformer 5A, and the output of inverter equipment 3B is connected to the delta coil for the input of output composition transformer 5B.
[0009] And the output voltage which the electrical potential difference 30 degrees of phases shifted [electrical potential difference] from the inverter equipments 3A and 3B mutually is inputted, and was compounded by the star coil of output composition transformer 5A and the double star coil of output composition transformer 5B becomes a thing adding the output voltage of the inverter equipments 3A and 3B at the output composition transformers 5A and 5B, respectively. And this compounded output voltage is outputted to the mass motor 6.
[0010] In addition, the cooling fan and motor which are not illustrated to the inverter equipments 3A and 3B in order to cool Rectifiers 9A and 9B, Inverters 10A and 10B, etc. are arranged, and in order to start a motor 6, turning gear and a motor are connected with the motor 6 through the clutch which is not illustrated.
[0011] In an above-mentioned configuration, in starting a motor 6, first, it starts by turning gear and raises a rotational frequency to 1% (it is 0.6Hz when commercial frequency is 60Hz) extent of rated frequency.
[0012] Then, a clutch is de**(ed) and it is made to speed oneself up to rated frequency with the inverter equipments 3A and 3B.
[0013] At this time, as shown in drawing 8 , as for the lowest frequency by the inverter equipments 3A and 3B which can be operated, it is desirable to carry out to 5% or more of rated frequency. And although a modulation factor rises in proportion to a frequency, the direct-current intermediate voltage ratio and the rate of the maximum current ratio (torque) are 100%.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, this invention does the following effectiveness so.
(a) Regenerative braking of a motor becomes possible and smooth and rapid halt and starting can be performed in low loss.
(b) By tap change-over of high pressure and the low-tension side, the minimum modulation factor constraint of an inverter can be avoided and smooth and quick adjustable cycle halt starting doubled with the motor property is attained.

(c) An inverter is effectively cooled according to actuation (heat release).

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] This invention adopts the following means in order to solve the above-mentioned technical problem.
(1) The inverter equipment for a motor drive characterized by to have the input transformer which has a high-pressure tap and a low-voltage tap, the inverter equipment which were connected to a high-pressure tap and a low-voltage tap through an input-voltage means for switching, the switch for an output which were connected to inverter equipment, the output transformer which were connected to the switch for an output, and the switch for a bypass which were connected to inverter equipment that an output transformer should bypass in the inverter equipment of a motor for a drive.
[0016] A low voltage tap turns on by the input voltage means for switching above at the time of motor starting. Moreover, the switch for a bypass turns on. And low voltage is inputted, and inverter equipment is the increment in a frequency defined beforehand, and it outputs the alternating current of a fixed current and drives a motor. A high-pressure tap turns on by the input voltage means for switching after that. Moreover, the switch for a bypass turns off and the switch for an output turns on. And inverter equipment inputs high pressure, is the increment in a frequency defined beforehand, and outputs the alternating current of a fixed current, and drives a motor after a pressure up with an output transformer.
[0017] Quick and smooth starting of a reliable motor is attained as mentioned above.
[0018] At the time of a motor halt, an input voltage means for switching, a high-pressure tap, a low voltage tap, the switch for an output, the switch for a bypass, etc. operate by the above and the reverse order, and slow down a motor. And direct-current braking is applied by inverter equipment, and it stops just before a halt.
[0019] A quick and smooth halt is attained by the reliable low loss of a motor as mentioned above.
(2) Inverter equipment is a control unit of the inverter equipment for a motor drive given in the above (1) characterized by having starting and stop control which has a rectifier, a smoothing capacitor, an inverter, and a motor for cooling fans, and carries out frequency control of the inverter equipment, and the cooling-fan drive and charging equipment which carry out frequency control of the motor for cooling fans while charging with a fixed current at a smoothing capacitor.
[0020] While a cooling-fan drive and charging equipment charge a smoothing capacitor with a fixed current with the control signal from starting and stop control above, the control drive of the motor for cooling fans is carried out, and an inverter is cooled.
(3) The operating method which starts in the motor by the inverter equipment for a motor drive given in the above (1) characterized by to turn ON the switch for a bypass, to make the output frequency of inverter equipment increase while switching an input-voltage means for switching to a low-voltage tap side, to turn ON the switch for OFF and an output for the switch for a bypass, and to make the output frequency of inverter equipment increase while switching an input-voltage means for switching to a high-pressure tap side after that.
[0021] A low voltage tap side turns on by the input voltage means for switching above at the time of starting, and the switch for a bypass turns on, and the output frequency of inverter equipment carries out a sequential increment, and puts a motor into operation. When it becomes a predetermined frequency, similarly, it switches to the high-pressure tap side ON, and the switch for OFF and an output turns [the switch for a bypass] on, and the output frequency of inverter equipment carries out a sequential increment, and carries out the accelerating drive of the motor.
(4) While connecting an input voltage means for switching to a high-pressure tap side, turn ON the switch for an output, decrease the output frequency of inverter equipment, and regenerative braking performs high-voltage moderation operation. While connecting an input voltage means for switching to a low voltage tap side next, turn ON a bypass switch, decrease the output frequency of inverter equipment, and regenerative braking performs low-battery

moderation operation. The operating method which suspends the motor by the inverter equipment for a motor drive given in the above (1) characterized by carrying out the output of inverter equipment to a direct current after that, and performing direct-current braking halt operation.
[0022] A high-pressure tap side turns on by the input voltage means for switching above at the time of a halt, and the switch for an output turns on, the output frequency of inverter equipment carries out sequential reduction, and a motor is slowed down. When it becomes a predetermined frequency, similarly, it switches to the low voltage tap side ON, and the switch for ON and an output turns [the switch for a bypass] off, the output frequency of inverter equipment carries out sequential reduction, and a motor is slowed down. Being flowing in one direction after that, a motor carries out direct-current braking.
[0023]
[Embodiment of the Invention] When drawing 1 - drawing 6 explain the gestalt of operation of this invention, drawing 1 is the circuit diagram of the 1st gestalt of operation of this invention, and drawing 2 is the circuit diagram of the output composition transformer of the 1st gestalt.
[0024] Drawing 3 is [the operation explanatory view of the 1st gestalt and drawing 5 of the flows-of-control Fig. at the time of starting of the 1st gestalt and drawing 4] the flows-of-control Figs. at the time of a halt of the 1st gestalt.
[0025] Drawing 6 is the circuit diagram of the 2nd gestalt of operation of this invention.
[0026] In addition, in drawing 1 and drawing 6 , the thing of the same sign as drawing 7 is a conventional thing and a conventional equal configuration member.
(Configuration of the 1st gestalt of operation of this invention) Drawing 1 - drawing 5 explain the gestalt of operation of this invention.
[0027] As shown in drawing 1 , when receiving high-voltage input power through an electric power switch 18, controlling a frequency by the inverter equipments 3A and 3B and driving the mass motor 6 of the high voltage, since rated voltage is low, as for the inverter equipments 3A and 3B, input transformer 1a for ****** is arranged.
[0028] Furthermore, while compounding the output of the inverter equipments 3A and 3B, in order to ****** output voltage to the rated voltage of a motor 6, the output composition transformers 5A and 5B are arranged.
[0029] In addition, although the inverter equipments 3A and 3B are made into 2 sets, this number of groups may be determined according to the capacity of a motor 6, as long as the capacity of a motor 6 is small, the number of inverter equipments one, and if it is large capacity more, according to the capacity of a motor 6, inverter equipment can be conversely made into 3 or more sets.
[0030] Input transformer 1a is constituted by the delta coil for an input, the star coil for an output, and the delta coil for an output.
[0031] And high-pressure input power is connected to the delta coil for an input through the electric power switch 18. The high-pressure tap a (electrical potential difference = HV) and the low voltage tap c (electrical potential difference = LV) are formed in the star coil for an output. Moreover, the high-pressure tap b (electrical potential difference = HV) is formed in the delta coil for an output.
[0032] In addition, although voltage ratio HV/LV is set to one third with the 1st gestalt of this operation, it is not limited to this.
[0033] The high-pressure tap a of input transformer 1a and the low voltage tap c are connected to inverter equipment 3A through switch 2A for a high-voltage input of the input voltage change-over machine 2, and switch 2B for a low-battery input, respectively.
[0034] Moreover, the high-pressure tap b of input transformer 1a is connected to inverter equipment 3B.
[0035] In addition, switch 2A for a high-voltage input and switch 2B for a low-battery input are interlocked, and are turned on in coincidence.
[0036] The inverter equipments 3A and 3B are constituted by the GTO inverters 10A and 10B for an output which change into a three-phase-circuit alternating current the smoothing capacitors 8A and 8B and direct current which carry out smooth [of the pulsating flow from the rectifiers 9A and 9B for 3 set full wave rectification, and Rectifiers 9A and 9B] respectively.
[0037] Furthermore, in order to emit the back flow power from a motor 6 at the time of a halt of a motor 6, the dampers 17A and 17B which consist of a resistor and a rectifier are formed in the inverter equipments 3A and 3B.
[0038] In addition, as for the GTO inverters 10A and 10B, the frequency of an output, the electrical potential difference, etc. are controlled by PWM (Pulse Density Modulation) control. In this PWM control, based on the modulated wave of the same frequency as a target frequency, and the subcarrier of 3 corniform of the frequency more than a modulated wave, switching of each inverters 10A and 10B is controlled, and a modulation factor, a pulse

number, pulse width, and the output voltage of an inverter change in proportion to a target frequency.
[0039] Moreover, a cooling fan and the cooling-fan motors 15A and 15B are respectively arranged by the inverter equipments 3A and 3B. Furthermore, charge Rhine 16 is connected to smoothing capacitors 8A and 8B. In addition, electric power is supplied to the power for the charge to the cooling-fan motors 15A and 15B and smoothing capacitors 8A and 8B from a cooling-fan drive and charging equipment 14A and 14B.
[0040] Electric power is supplied to the output of inverter equipment 3A by the mass motor 6 via switch 4B for a bypass of the output transformer bypass change-over machine 4.
[0041] Furthermore, the output of inverter equipment 3A is connected to the delta coil for an input of output composition transformer 5A as shown in switch 4for high-voltage output A of the output transformer bypass change-over machine 4, and drawing 2 .
[0042] On the other hand, the output of inverter equipment 3B is connected to the delta coil for an input of output composition transformer 5B as shown in drawing 2 .
[0043] And the double star coil for an output of output composition transformer 5B is connected to the end of the star coil for an output of output composition transformer 5A, thereby, the output of 2 sets of inverter equipments 3A and 3B is compounded, and the other end of the star coil for an output of output composition transformer 5A is connected to the mass motor 6 via contact 4C for a bypass of the output transformer bypass change-over machine 4.
[0044] In addition, the switches 4A and 4C for a high-voltage output of the output transformer bypass change-over machine 4 and switch 4B for a bypass are interlocked, and are turned on in coincidence.
[0045] Moreover, the motor 6 is connected with the turning-gear motor 13 through clutch 13A. Moreover, the rotation detector 7 is attached in the motor 6.
[0046] And in order to control each above-mentioned equipment, starting and stop control 11, a cooling-fan drive and charging equipment 14A and 14B, and the turning-gear control unit 12 are arranged.
[0047] Starting and stop control 11 control turning on and off of the input voltage change-over machine 2 and the output transformer bypass change-over machine 4.
[0048] Moreover, starting and stop control 11 perform generalization control of the turning-gear control unit 12, and a cooling fan and charge control units 14A and 14B.
[0049] Furthermore, starting and stop control 11 send the switching signal of the inverter of the inverter equipments 3A and 3B for carrying out PWM (pulse width modulation) control according to a target frequency.
[0050] The turning-gear control device 12 controls attachment and detachment of the drive of the turning-gear motor 13, and clutch 13A.
[0051] A cooling-fan drive and charging equipment 14A and 14B are constituted by the inverter which is not illustrated, the pressure-up transformer, and the rectifier.
[0052] And at the time of operation of the cooling-fan motors 15A and 15B, the above-mentioned inverter performs revolving speed control of the cooling-fan motors 15A and 15B. Moreover, at the time of fixed current charge of smoothing capacitors 8A and 8B, it charges with a fixed current through charge Rhine 16 with the above-mentioned inverter, a pressure-up transformer, and a rectifier.
(Control of starting of the 1st gestalt of operation of this invention) In an above-mentioned configuration, starting of a motor 6 is controlled to be shown in the flows of control of drawing 3 .
[0053] The control at the time of starting is classified into three big steps.
[0054] That is, if mechanical driving gears (turning gear etc.) perform a crawling starting process first (step 2), the decrease electrical-potential-difference inverter starting process by the low battery is performed on the frequency of 0.6Hz (1% of a nominal speed) (step 3) and a frequency finally amounts to 6Hz (10% of a nominal speed), input voltage will be switched to the high voltage (rated voltage), and a rated voltage inverter starting process (step 3) will be performed.
[0055] Below, it explains per detail of each steps 2, 3, and 4.
[0056] First, an electric power switch 18 and all switch 2A, 2B, and 4A, 4B and 4C check that it is off before starting initiation (step S11).
[0057] And a starting start signal is transmitted to the turning-gear control unit 12, and a cooling-fan drive and charging equipment 14A and 14B from starting and stop control 11 (step S12).
[0058] In the crawling starting process of step 2, first, with the turning-gear control device 12, a starting start signal is received and clutch 13A is inserted in (step S21).
[0059] And the turning-gear motor 13 is driven, a motor 6 is started and a predetermined time (T1) speedup is carried out (step S22).

[0060] In addition, this predetermined time (T1) is based on the starting performance of a motor 6, and is calculated and set up beforehand.
[0061] If the engine speed of a motor 6 speeds itself up to lowest frequency f1 =0.6Hz (1% of rated frequency), while de**(ing) clutch 13A, the turning-gear motor 13 is turned OFF and a turning completion signal is sent to starting and stop control 11 (step S23).
[0062] This completes the crawling starting process of step 2.
[0063] On the other hand, in parallel to the crawling starting process of step 2, by a cooling-fan drive and charging equipment 14A, a starting start signal is received and it charges with a fixed current to smoothing capacitor 8A (step S61).
[0064] In addition, inverter equipment 3A ends this charge, when it becomes an electrical potential difference (low battery) in case the electrical potential difference of smoothing capacitor 8A is [switch 2B for a low-battery input] ON.
[0065] Furthermore, in parallel to the crawling starting process of step 2, a cooling-fan drive and charging equipment 14B also receive a starting start signal, and charges with a fixed current to smoothing capacitor 8B (step S62).
[0066] In addition, the electrical potential difference of smoothing capacitor 8B ends this charge, when it becomes rated voltage.
[0067] Next, it sets in the decrease electrical-potential-difference inverter starting process of step 3. In starting and stop control 11 A turning completion signal is received and the completion signal of charge is also received if needed from a cooling fan and the charge control units 14A and 14B (in addition, reception of each completion signal of charge). it may be before ON of an electric power switch 18, in order to connect an input to the low voltage tap c side, after carrying out Switch 2B for a low-battery input of the input voltage change-over machine 2 is turned ON, and further, in order to bypass an output transformer 5, switch 4B for a bypass of the output transformer bypass change-over machine 4 is turned ON (step S31). An electric power switch 18 is turned ON after that (step 32), and electric supply is started.
[0068] And with a low battery (LV), the switching signal which predetermined time (T2) and a frequency **** is transmitted to inverter 10A (step S33), and accelerating operation is performed until it is set to change-over frequency f2 =6Hz (10% of rated frequency) from lowest frequency f1 =1.2Hz if needed [the time schedule or if needed] which was set up beforehand by making the signal of the number of rotations of the motor from the rotation detector 7 into a feedback signal.
[0069] In addition, although an electrical potential difference also rises in proportion to a frequency, since it is considering as the low battery, as shown in drawing 4 , direct-current intermediate voltage is usual 1/3.
[0070] In order to obtain the output voltage ratio usual in this condition, the modulation factor is increased about 3 usual times (=HV/LV). For this reason, the rate of the maximum current ratio to the rated current of a motor 6 is pressed down to 150%.
[0071] Then, after detecting that the rotational frequency was set to change-over frequency f2 =6Hz from the rotation detector 7 and turning OFF (step 34) the period of predetermined time (T3), and an electric power switch 18, while also turning OFF switch 2B for a low-battery input of the input voltage change-over machine 2, switch 4B for a bypass of the output transformer bypass change-over machine 4 is also turned OFF (step S35).
[0072] This completes the decrease electrical-potential-difference inverter starting process of step 3.
[0073] Moreover, with a cooling-fan drive and charging equipment 14A and 14B, it charges with a fixed current to smoothing capacitors 8A and 8B between predetermined time (T3) (in addition, after step 34 is available for initiation of this the charge of each). (step S63, step S64)
[0074] The electrical potential difference of smoothing capacitors 8A and 8B ends this charge, when the inverter equipments 3A and 3B become an electrical potential difference (high voltage/rated voltage) in case switch 2A for a high-voltage input is ON.
[0075] In addition, since it has not carried out movable [of the inverter equipment 3B] at step 3, smoothing capacitor 8B is in a condition [having charged at step 62], and charge of step 64 is ideally unnecessary.
[0076] However, since the charge electrical potential difference is falling by leakage when the period of step 3 is long, it charges again. Therefore, step 64 is unnecessary what has the short period of step 3.
[0077] Next, it shifts to the rated voltage inverter starting process of step 4.
[0078] In starting and stop control 11, after predetermined time (T3) progress and after also receiving the completion signal of high-voltage charge if needed from a cooling-fan drive and charging equipment 14A and 14B (before ON of an electric power switch 18 is convenient for reception of each completion signal of charge in addition), in order to connect an input to the high-pressure tap a side, switch 2A for a high-voltage input of the input voltage change-over

machine 2 is turned ON.
[0079] Furthermore, since output composition transformer 5A is minded, the switches 4A and 4C for a high-pressure output of the output transformer bypass change-over machine 4 are turned ON (step S41).
[0080] Then, it energizes by turning ON an electric power switch 18.
[0081] With the inverter equipments 3A and 3B, the high-pressure middle direct current voltage of smoothing capacitors 8A and 8B is switched by using the number signal of rotations from the rotation detector 7 as the base, the alternating current power which goes up from the change-over frequency f2 to an operation frequency by the predetermined pattern (the minimum modulation factor) is outputted, and accelerating operation is performed (step S43).
[0082] In this case, as shown in drawing 4 , direct-current intermediate voltage and the rate of the maximum current ratio are 100%, and the modulation factor has also become the usual thing.
[0083] A motor 6 will receive this alternating current power through the output composition transformers 5A and 5B, rotation will be raised according to an input, it will be in operational status, starting is completed, and it usually operates (step S5).
[0084] Quick and smooth starting of a motor 6 is attained as mentioned above.
[0085] In addition, in a cooling-fan drive and charging equipment 14A and 14B, the completion signal of a high-pressure switch is received from starting and stop control 11, and operation of the cooling-fan motors 15A and 15B and frequency control are started (in addition (steps S65 and S66), after step 42 is available for initiation of this operation of each).
[0086] This frequency is respectively controlled according to the temperature of the inverters 10A and 10B of the inverter equipments 3A and 3B etc.
[0087] In addition, when the charge to smoothing capacitors 8A and 8B is unnecessary, control of steps S61, S62, S63, S64, and S65 can be omitted.
[0088] Moreover, it is not necessary to double strictly the charge electrical potential difference to smoothing capacitors 8A and 8B with the electrical potential difference at the time of operation of the GTO inverters 10A and 10B. Namely, what is necessary is just about 100% **30 - 40% of an electrical potential difference at the time of operation that what is necessary is just to charge to the electrical potential difference of extent which can prevent an excessive current at the time of the injection when turning on an electric power switch 18.
[0089] Furthermore, in not performing revolving speed control of the cooling-fan motors 15A and 15B (namely, fixed rotation operation), control of steps S64 and S65 is only turning on an electric power switch.
(Control of a halt of the 1st gestalt of operation of this invention) Next, a halt of a motor 6 is performed, as shown in the flows of control of drawing 5 .
[0090] The control at the time of a halt is classified into three big steps.
[0091] Namely, 2 sets of inverter equipments 3A and 3B perform the high-voltage moderation process by regenerative braking by the high voltage first (step 7). If a frequency amounts to 3Hz (5% of a nominal speed), inverter equipment 3A will perform the low-battery moderation process by regenerative braking (step 7). If a frequency finally amounts to 1.2Hz (2% of a nominal speed), the direct-current braking moderation process (step 9) by inverter equipment 3A will be performed, and it is made to stop.
[0092] Below, it explains per detail of each steps 7-9.
[0093] First, a halt start signal is sent by hand control etc. (step 6).
[0094] And in a high-voltage moderation process (step 7), that a frequency and an electrical potential difference should be descended from an operation frequency (60Hz) with time amount to the change-over frequency f3 (3Hz) according to a halt pattern, by making the signal from the revolution-rate-detection machine 7 into a feedback signal, starting and stop control 11 reduce a modulation factor, and goes by the input of the high voltage.
[0095] And according to this modulation factor, the switching signal of the inverters 10A and 10B of the inverter equipments 3A and 3B is sent (step S71).
[0096] That is, the output frequency of the inverter equipments 3A and 3B is reduced so that the skid of an induction motor 6 may be subtracted.
[0097] Then, a motor 6 generates the power according to the skid. This generated power is returned to the inverter equipments 3A and 3B, and is consumed by the resistor of the dampers 17A and 17B in inverter equipment 3A and 3B.

[0098] Thus, moderation operation of the motor 6 is carried out by regenerative braking by the high voltage.
[0099] And it detects that the signal from the rotational frequency detector 7 was set to 3Hz or less (step 72), and shifts

to the following low-battery moderation process (step 8).
[0100] In a low-battery moderation process (step 8), the power-source step 18 is turned OFF first (step 81).
[0101] Then, at a cooling-fan drive and charging equipment 14B, it charges with a fixed current to smoothing capacitor 8B (step S67). This charge is ended when the electrical potential difference of smoothing capacitor 8B becomes the same as the electrical potential difference (high voltage/rated voltage) of inverter equipment 3A in case switch 2A for a high-voltage input is ON. And operation of inverter equipment 3B is ended. Moreover, operation of cooling-fan motor 15B by a cooling-fan drive and charging equipment 14B is also suspended.
[0102] And after turning OFF switch 2for high-voltage input A, and the switches 4A and 4C for a high-voltage output with starting and stop control 11 in order to switch an input to a low voltage tap side, switch 2B for a low-battery input and switch 4B for a bypass are turned ON (step S82).
[0103] Then, after also receiving the completion signal of high-voltage charge from a cooling-fan drive and charging equipment 14B again if needed, an electric power switch 18 is turned OFF (step 83).
[0104] That a frequency and an electrical potential difference should be descended from an operation frequency (3Hz) with time amount to the change-over frequency f4 (1.2Hz) according to a halt pattern, by making the signal from the revolution-rate-detection machine 7 into a feedback signal, starting and stop control 11 reduce a modulation factor, and goes by the input of a low battery.
[0105] And the switching signal of inverter 10A of inverter equipment 3A according to this modulation factor is sent (step S84).
[0106] That is, the output frequency of the inverter equipments 3A and 3B is reduced so that the skid of an induction motor 6 may be subtracted.
[0107] Then, a motor 6 generates the power according to the skid. This generated power is returned to inverter equipment 3A, and is consumed by the resistor of damper 17A in inverter equipment 3A.
[0108] Thus, moderation operation of the motor 6 is carried out by regenerative braking by the low battery.
[0109] And it detects that the signal from the rotational frequency detector 7 was set to 1.2Hz or less (step 85), and shifts to the following direct-current braking process (step 9).
[0110] In a direct-current braking process (step 9), inverter 10of inverter equipment 3A A is controlled by starting and stop control 11, and direct-current braking operation is performed with it.
[0111] namely, the motor 6 -- direct current voltage (or low frequency to reverse) -- in addition, the stator of a motor 6 is made to generate a nonrotation field (or rotating magnetic field of the low frequency to reverse) Then, a short-circuit current flows to the rotator of a motor 6, and a brake force occurs.
[0112] Thus, brakes are applied for a frequency from the change-over frequency f4 (1.2Hz) to 0 (step S92).
[0113] Thereby, a motor 6 completes a halt quickly and smoothly by direct-current braking (step S10).
[0114] Like the above, starting and a halt of the mass motor 6 are performed quickly and smoothly by low loss.
(Configuration of the 2nd gestalt of operation of this invention) Drawing 6 explains the 2nd gestalt of operation of this invention.
[0115] In drawing 6 , the thing of the same sign as drawing 1 is the 1st gestalt and equal configuration member of operation of this invention.
[0116] In the 2nd gestalt of operation of this invention, since a motor 6 is below the rated capacity of inverter equipment 3A, a different point from the 1st gestalt is having made inverter equipment 3A, cooling-fan and motor 15A, and a cooling-fan drive and charging equipment 14A into 1 set.
[0117] Therefore, the coil for an output is made into one piece in input transformer 1b, and an output transformer 5 turns into a mere pressure-up transformer.
(Control of the 2nd gestalt of operation of this invention) The same control as control of starting and a halt of the 1st gestalt of operation of this invention which control of starting and a halt of the 2nd gestalt of operation of this invention shows to drawing 3 and drawing 5 except inverter equipment 3A, cooling-fan and motor 15A, and a cooling-fan drive and charging equipment 14A being 1 set is performed.
[0118] That is, in the control at the time of starting shown in drawing 3 , steps S62, S64, and S66 become unnecessary.
[0119] Moreover, in the control at the time of a halt shown in drawing 5 , steps S67 and S68 become unnecessary.
[0120] As mentioned above, although inverter equipment, a cooling fan and a motor, and a cooling-fan drive and charging equipment explained per 1 set or 2 sets of gestalten, they are not limited to this and can apply similarly [in the case of 3 or more sets].
[0121] Moreover, in each example, since the electric power switch 18 is turned on and off whenever it switches, each switch of the input voltage change-over machine 2 and the output transformer bypass change-over machine 4 can adopt

the cheap contactor for a non-energized change-over, a disconnector, a contact, etc.
[0122] As explained above, the following effectiveness is done so in the gestalt of each operation.
** The torque fall and overcurrent generating at the time of starting are lost.
** By tap change-over of high pressure and the low-tension side, the minimum modulation factor constraint of an inverter can be avoided and smooth and quick adjustable cycle starting doubled with the motor property is attained.
** By tap change-over of high pressure and the low-tension side, the minimum modulation factor constraint of an inverter can be avoided, regenerative braking becomes possible to a low frequency and an electrical potential difference, and smooth and quick moderation operation doubled with the motor property is attained.
** A halt of the motor by direct-current braking is further attained by tap change-over of the low-tension side.
** the large capacity which cannot perform halt and starting only with one inverter by using two or more two inverters and output composition transformers -- it also receives electric and the above-mentioned starting, operation, and a halt are attained.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the circuit diagram of the 1st gestalt of operation of this invention.
[Drawing 2] It is the circuit diagram of the output composition transformer section of the 1st gestalt.
[Drawing 3] It is a flows-of-control Fig. at the time of starting of the 1st gestalt.
[Drawing 4] It is the operation explanatory view of the 1st gestalt.
[Drawing 5] It is a flows-of-control Fig. at the time of a halt of the 1st gestalt.
[Drawing 6] It is the circuit diagram of the 2nd gestalt of operation of this invention.
[Drawing 7] It is the circuit diagram of the conventional example.
[Drawing 8] It is the operation explanatory view of the conventional example.
[Description of Notations]
1a, 1b, 01 Input transformer
2 Input Voltage Change-over Machine
2A The switch for a high-voltage input
2B The switch for a low-battery input
3A, 3B Inverter equipment
4 Output Transformer Bypass Change-over Machine
4A, 4C Switch for a high-voltage output
4B The switch for a bypass
5 Output Pressure-Up Transformer
5A, 5B Output composition transformer
6 Motor
7 Rotation Detector
8A, 8B Smoothing capacitor
9A, 9B Rectifier
10A, 10B GTO inverter
11 Starting and Stop Control
12 Turning-Gear Control Unit
13 Turning-Gear Motor
13A Clutch
14A, 14B A cooling-fan drive and charging equipment
15A, 15B Cooling-fan motor
16A, 16B Charge Rhine
17A, 17B Damper
18 Electric Power Switch
High-pressure tap (electrical potential difference = HV)
b High-pressure tap (electrical potential difference = HV)
c Low voltage tap (electrical potential difference = LV)

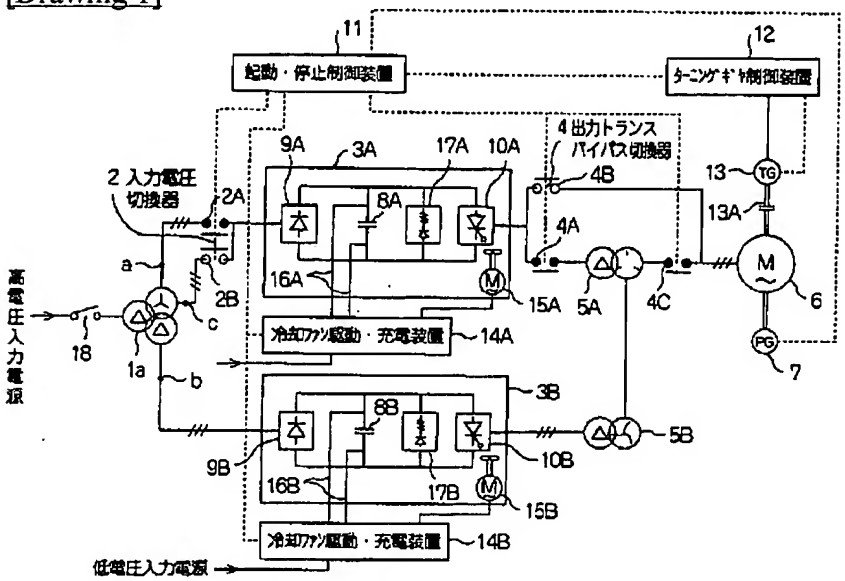
[Translation done.]

* NOTICES *

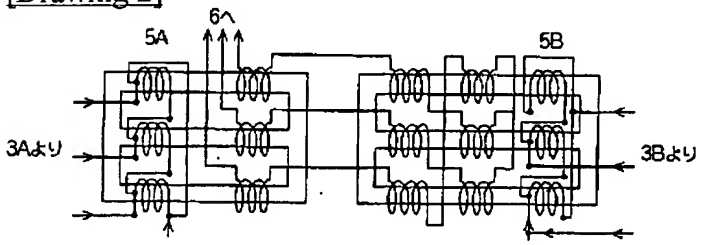
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

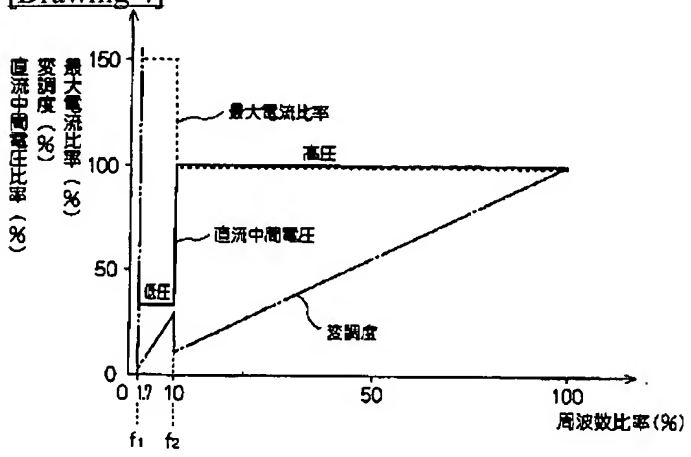
[Drawing 1]



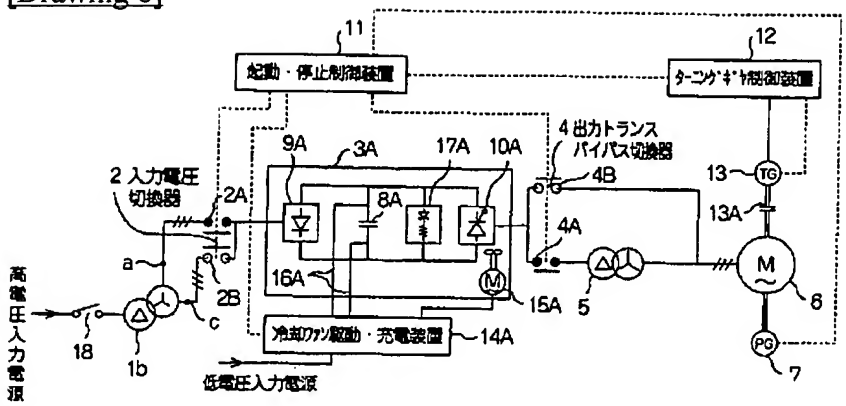
[Drawing 2]



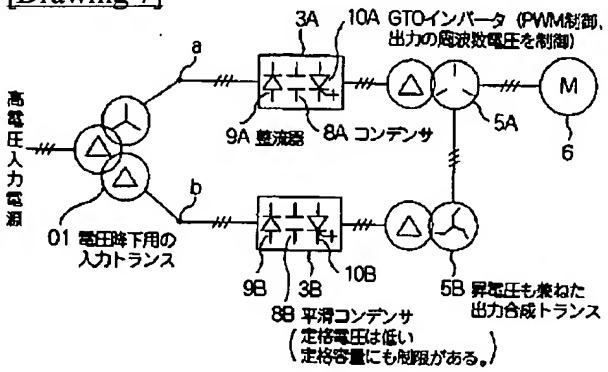
[Drawing 4]



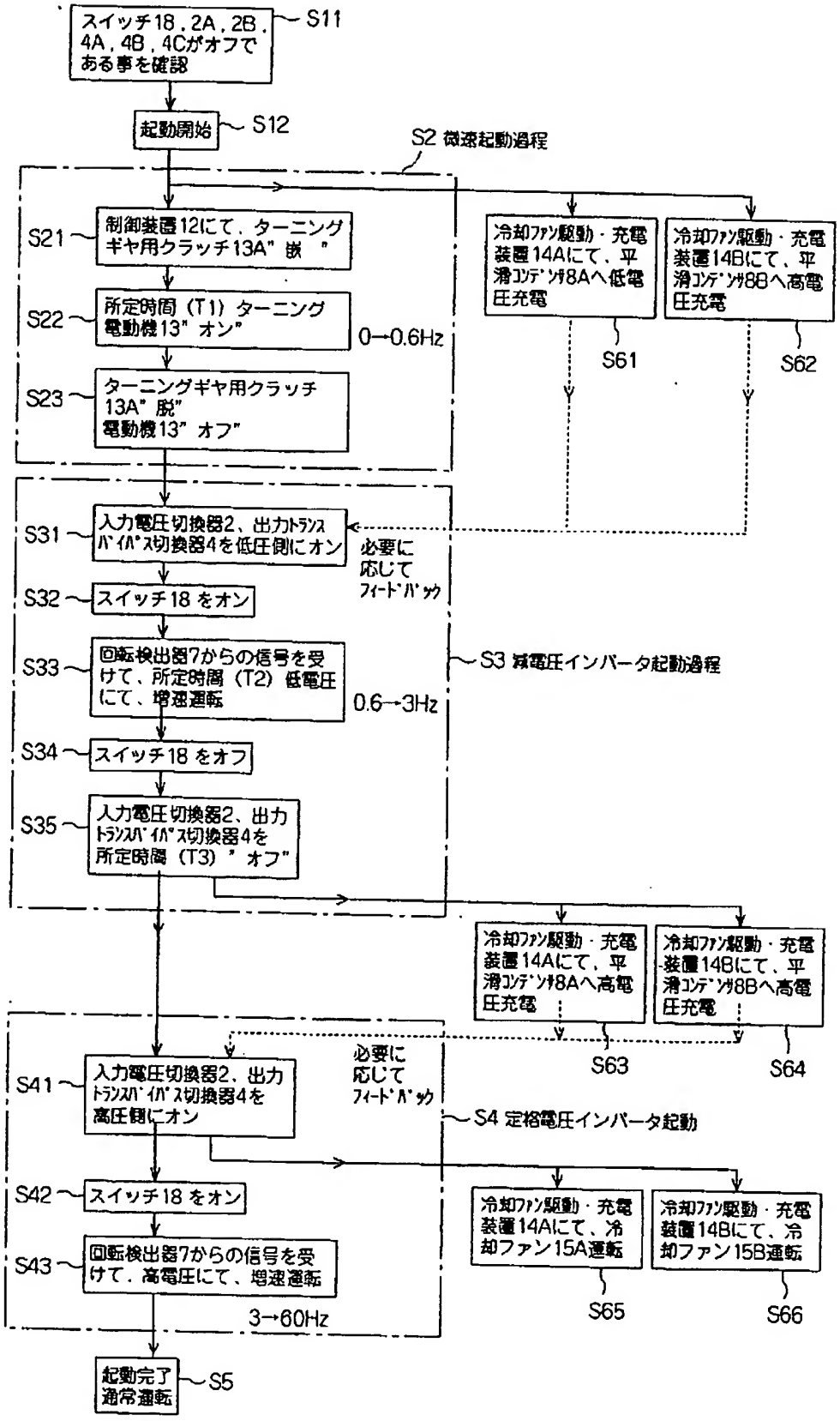
[Drawing 6]



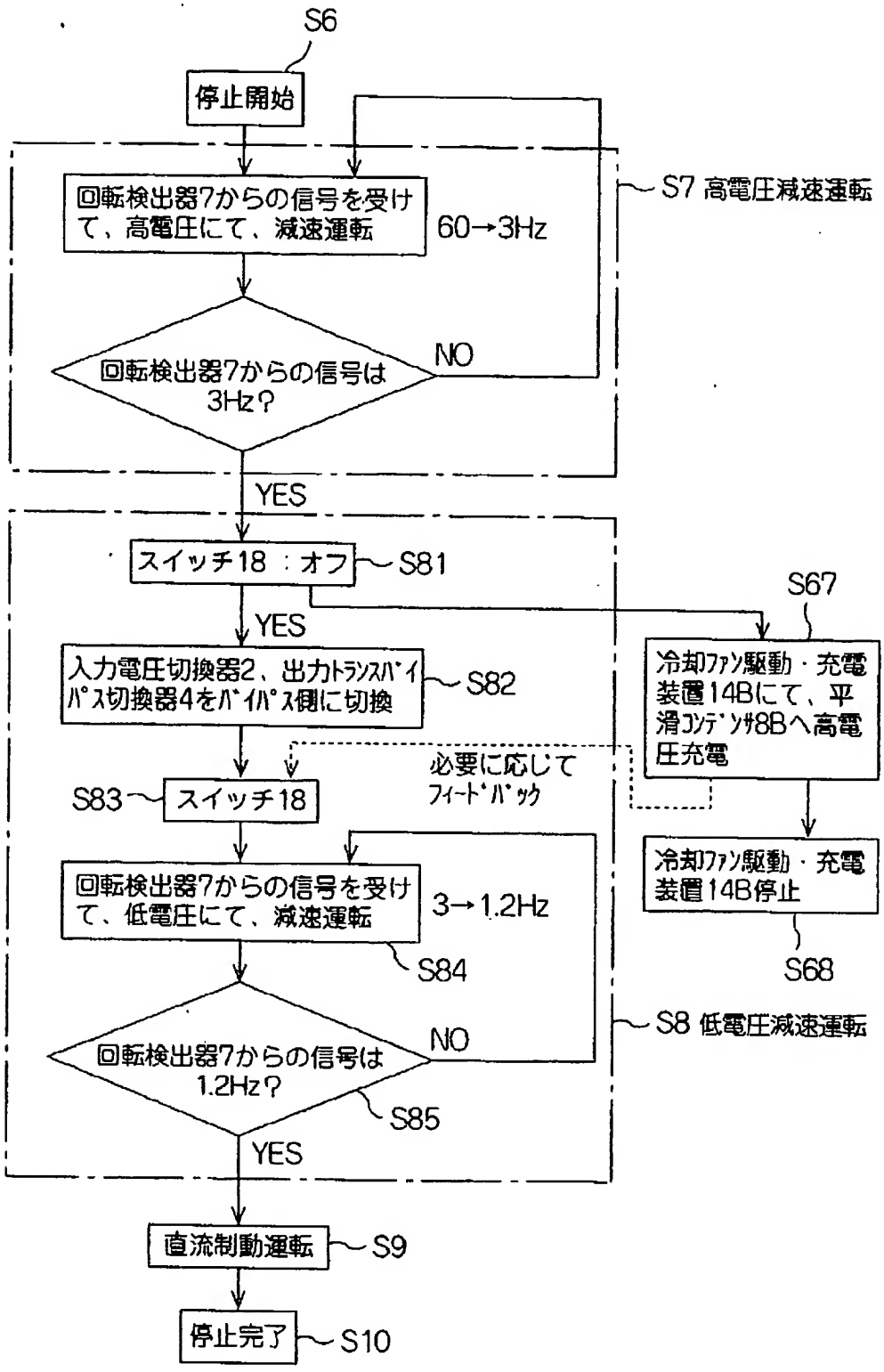
[Drawing 7]



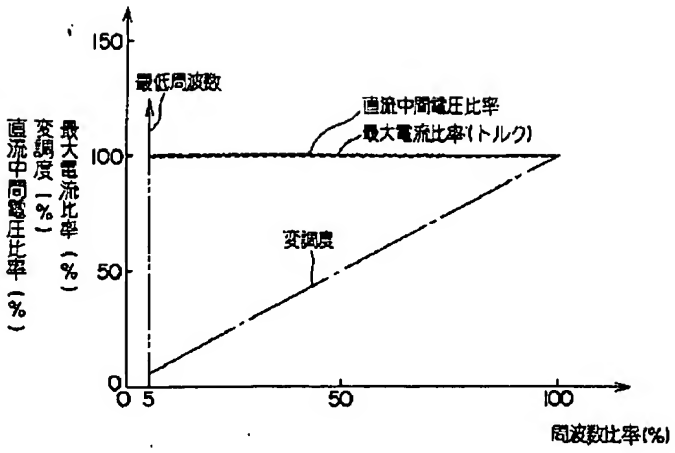
[Drawing 3]


スイッチ18，2A，2B，4A，4B，4Cがオフである事を確認
S11
起動開始
S12
S2 微速起動過程
S21
制御装置12にて、ターニングギヤ用クラッチ13A" 嵌 "
S22
所定時間（T1）ターニング電動機13" オン"
0→0.6Hz
S23
ターニングギヤ用クラッチ13A" 脱"
電動機13" オフ"
冷却ファン駆動・充電装置14Aにて、平滑コンデンサ8Aへ低電圧充電
冷却ファン駆動・充電装置14Bにて、平滑コンデンサ8Bへ高電圧充電
S61
S62
S31
入力電圧切換器2、出力トランスバイパス切換器4を低圧側にオン
必要に応じてフィードバック
S32
スイッチ18をオン
S33
回転検出器7からの信号を受けて、所定時間（T2）低電圧にて、増速運転
0.6→3Hz
S3 減電圧インバータ起動過程
S34
スイッチ18をオフ
S35
入力電圧切換器2、出力トランスバイパス切換器4を所定時間（T3）" オフ"
冷却ファン駆動・充電装置14Aにて、平滑コンデンサ8Aへ高電圧充電
冷却ファン駆動・充電装置14Bにて、平滑コンデンサ8Bへ高電圧充電
S63
S64
必要に応じてフィードバック
S41
入力電圧切換器2、出力トランスバイパス切換器4を高圧側にオン
S4 定格電圧インバータ起動
S42
スイッチ18をオン
S43
回転検出器7からの信号を受けて、高電圧にて、増速運転
3→60Hz
冷却ファン駆動・充電装置14Aにて、冷却ファン15A運転
冷却ファン駆動・充電装置14Bにて、冷却ファン15B運転
S65
S66
起動完了通常運転
S5

[Drawing 5]


S6
停止開始
回転検出器7からの信号を受けて、高電圧にて、減速運転
60→3Hz
S7 高電圧減速運転
回転検出器7からの信号は3Hz?
NO
YES
スイッチ18 : オフ
S81
S67
YES
入力電圧切換器2、出力トランスバイパス切換器4をバイパス側に切換
S82
冷却ファン駆動・充電装置14Bにて、平滑コンデンサ8Bへ高電圧充電
必要に応じてフィードバック
S83
スイッチ18
回転検出器7からの信号を受けて、低電圧にて、減速運転
3→1.2Hz
冷却ファン駆動・充電装置14B停止
S84
S68
回転検出器7からの信号は1.2Hz?
NO
S85
S8 低電圧減速運転
YES
直流制動運転
S9
停止完了
S10

[Drawing 8]



[Translation done.]